CALIFORNIA
AIR RESOURCES BOARD

California Vehicle Fill Pipe Specifications

Potential Improvements

December 13-14, 2017

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Agenda

- Background
  - Performance in the field
  - Voluntary solutions by Manufacturers
- Changes to Specifications
  - Performance
  - Dimension
  - Other changes
- Regulation Timeline

BACKGROUND

Current Key CA Fill Pipe Specifications

- Virtually unchanged since 1970's
- 2014 and earlier: In CA specification
- 2015 and later: Reference ISO 13331:1995
- Dimensional requirements
  - Pipe opening and locking lip
  - Access zone around pipe does not obstruct nozzle
  - Sealing surface should allow for good seal w/nozzle

How does fill pipe design impact overpressure?

Drain Hole

- MLD's 2015 testing:
  - >1000 consumer fueling events
  - Certain vehicles frequently had high V/L.
- Capless fill pipes:
  - Drain Holes
- Capped fill pipes:
  - Deep locking lip requiring large force to latch nozzle
- Both capless and capped:
  - Items in access zone blocking nozzle sealing

Initial work with manufacturers to find solutions

Certification Previews

- Reviewed auto manufacturer's fill pipes and provided clarification
- Capless becoming more popular

OEMs provided countermeasures for future product

- Many capless designs had compatibility / dimensional issues:
  - Holes: both for drain and/or mating parts
  - Diameter out of spec

Regulation update will provide solution

- Most capped designs meet specification
  - No countermeasures provided for designs w/ high V/L which clearly met the specification

Plans for Improvements

CHANGES TO THE SPECIFICATIONS

Proposed Changes

I. Add a performance test / standard (nozzle to pipe interface)

II. Dimension changes to better accommodate today's nozzles

III. Remove option to forgo spitback/PSO testing

IV. Possible change-over: ISO 13331 → SAE J1140

V. Other minor changes

Collaboration with SAE and industry

- SAE Fuel Systems J285/J1140 Task Force
  - Auto, nozzle, and fill pipe manufacturers
  - Assisted with developing many of the planned changes
  - Performed testing to support new standards and dimensions

DEVELOPMENT OF A PERFORMANCE SPECIFICATION

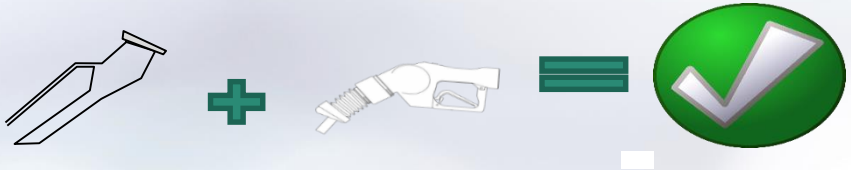
Goal: Restrict Open Ports to Atmosphere

Spec currently requires good seal at pipe face

- But this is useless if there is an opening elsewhere

Suggested change: add performance standard

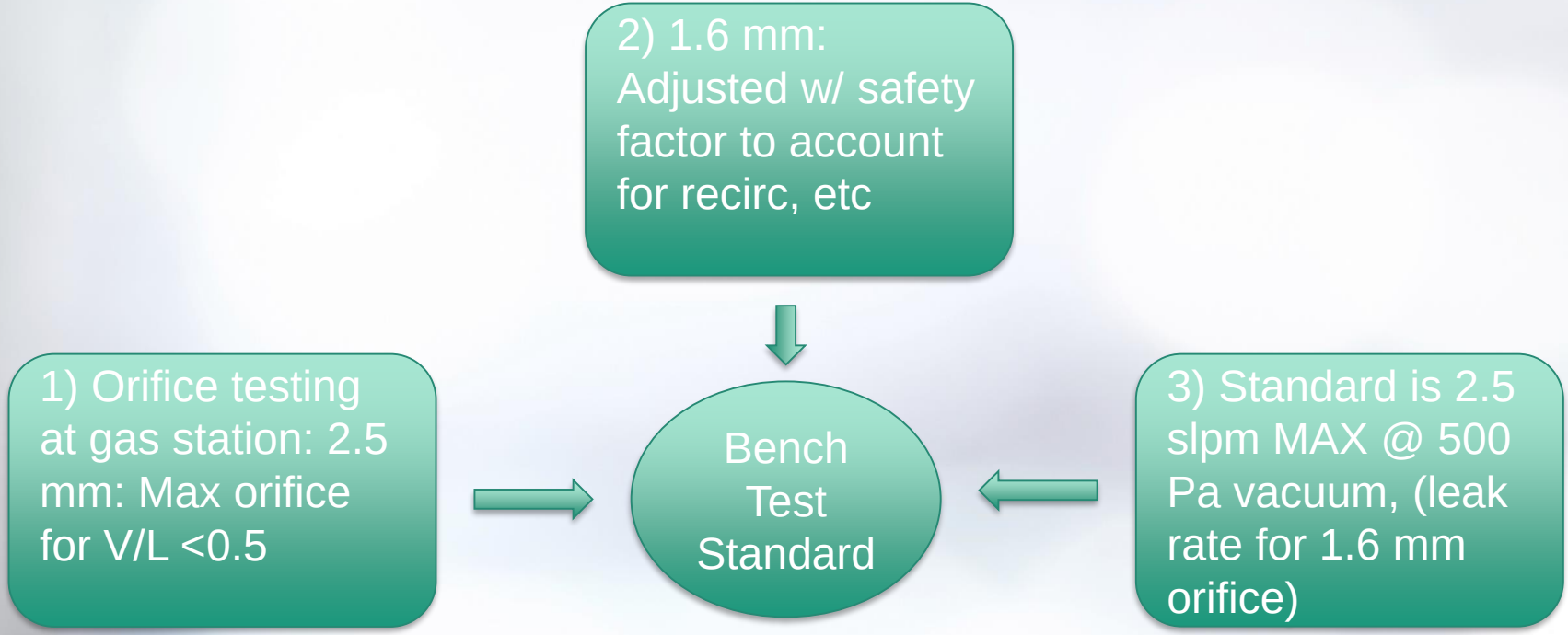
- Tests quality of nozzle seal to fill pipe (interface)



Planned Compliance Options

- Option A: V/L data using real gas dispensing equipment
  - Standard = Max allowable V/L
- Option B: Bench test of leak performance (surrogate to V/L data)
  - Component level test of the fill pipe and nozzle
  - No gasoline is dispensed
  - Standard = Max allowable leak rate
- Option C: Alternative to testing
  - Attest there are no holes and pipe mating parts are sealed
- CARB may verify performance

Summary: Bench Test Standard Development



Bench Test: Orifice Size

- Combined data from CARB, auto industry, SAE Fuel Systems J285/J1140 Task Force
- Orifice size (maximum) determined
  - Implanted orifices in fill pipes
  - Performed actual refueling at GDF
  - Measured V/L
  - A 2.5 mm orifice size can still yield a good V/L (below 0.5)

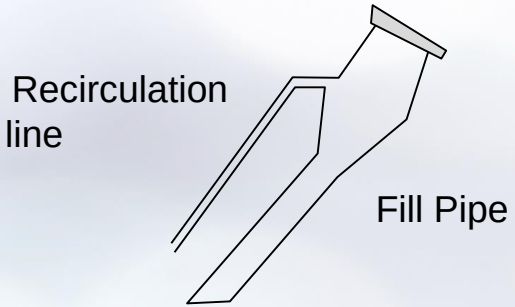
Bench Test: Supporting Data

Source:	Added Orifice:	Recirculation line?	V/L:
OEM A / CARB	2.5 mm	No	0.19
OEM A / CARB	2.5 mm	Yes	0.39
OEM B / CARB	2.4 mm	No	0.1 = Δ *

* Δ is increase in V/L when orifice was added

Bench Test: Adjusting for recirc's effect

- Considering 1.6 mm maximum orifice size
- Allows some safety factor to account for variation in designs
  - E.g. recirculation lines



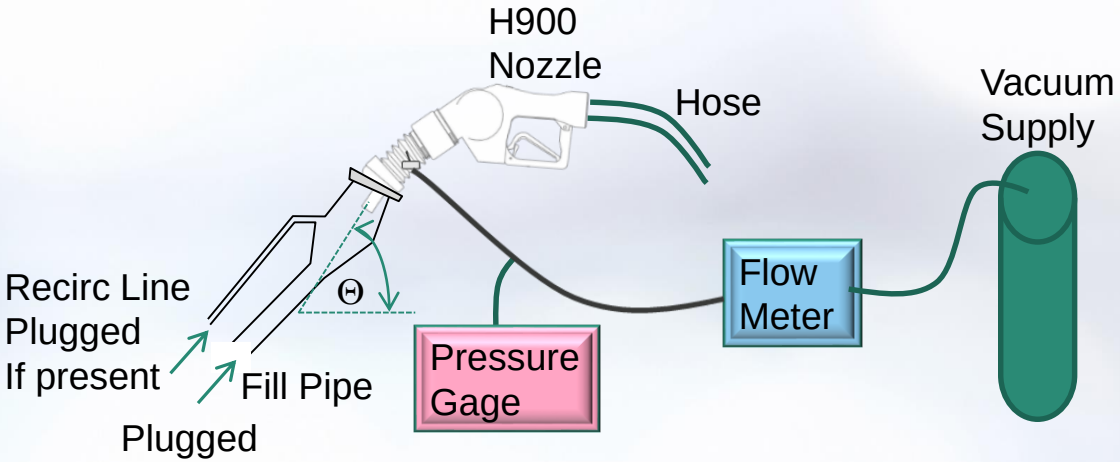
Bench Test: Planned Standard

- Converted 1.6 mm orifice size into a bench test flow rate @ set pressure
  - Both CARB and some OEMs have performed bench testing
- Bench leak test with 1.6 mm orifice:

Planned Standard:
2.5 slpm MAX flow @ 500 Pascal vacuum

CARB's Bench Test Method + Equipment

- Adjust vacuum supply: -500 Pascal @ pressure gage
- Output = leak rate in liters per minute @ flow meter
  - Compare with standard: 2.5 liters per minute



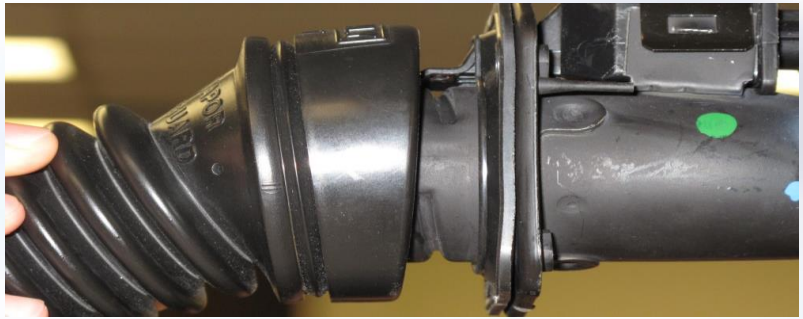
CARB's Bench Test Set-up

Front view

Side view

DIMENSIONAL CHANGES

Access Zone Update: Why its needed

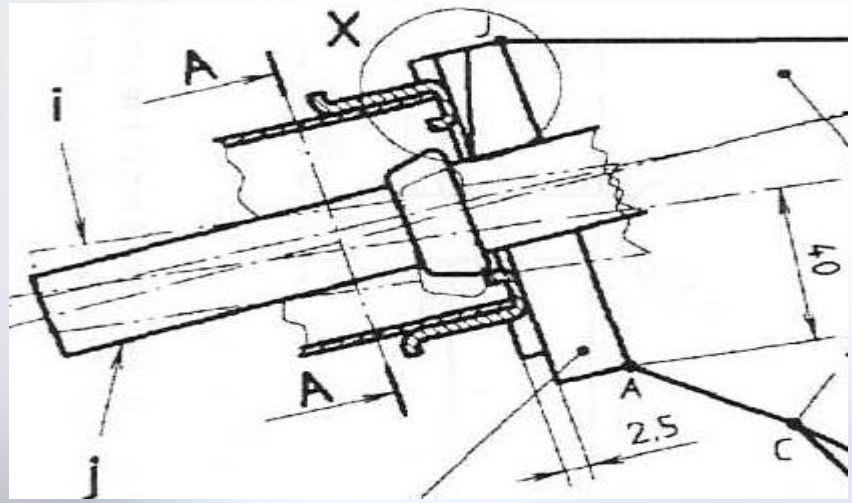


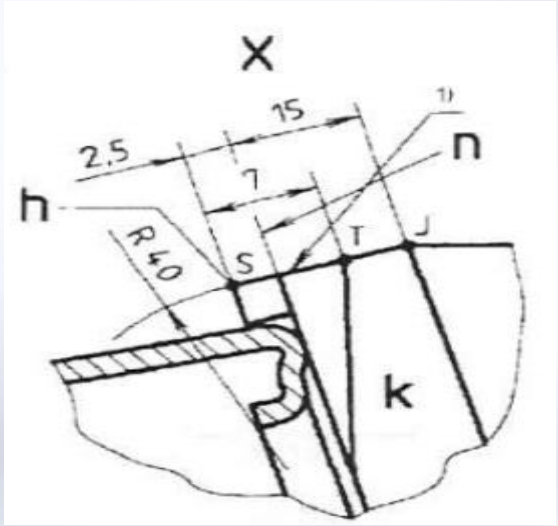
Boot overlaps fill pipe

Access Zone Update Plan

- Clarify and improve fill pipe's access zone
  - To represent today's nozzles
- Adds to current access zone in ISO 13331
- Purpose of access zone:
  - Leave space on vehicle for nozzle insertion
- The change makes room for concave nozzle boot
  - Allows boot to overlap fill pipe
  - Enable boot to seal with fill pipe
- Worked with SAE Fuel Systems J285/J1140 Task Force

Current Fill Pipe Access Zone

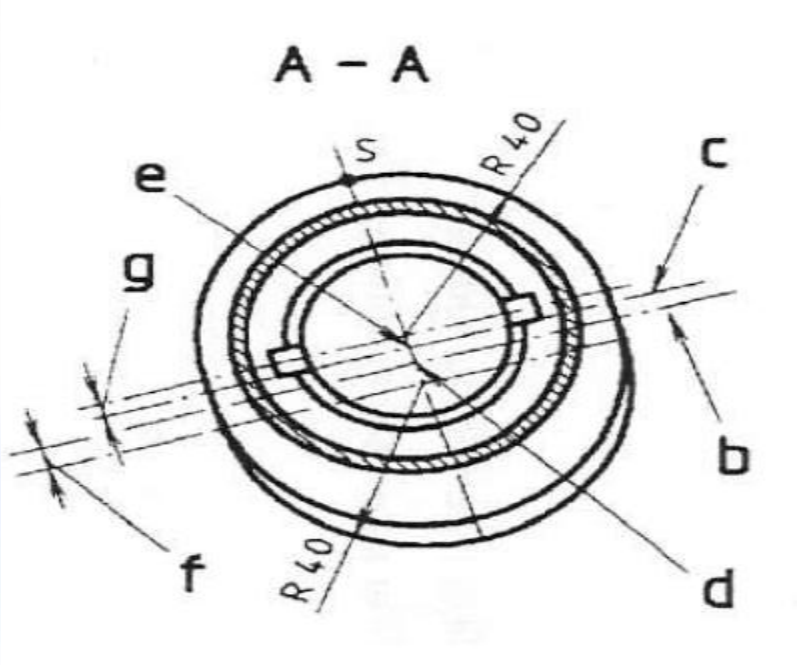




(axial view)

Excerpt From: ISO 13331:1995(E)

Current Fill Pipe Access Zone



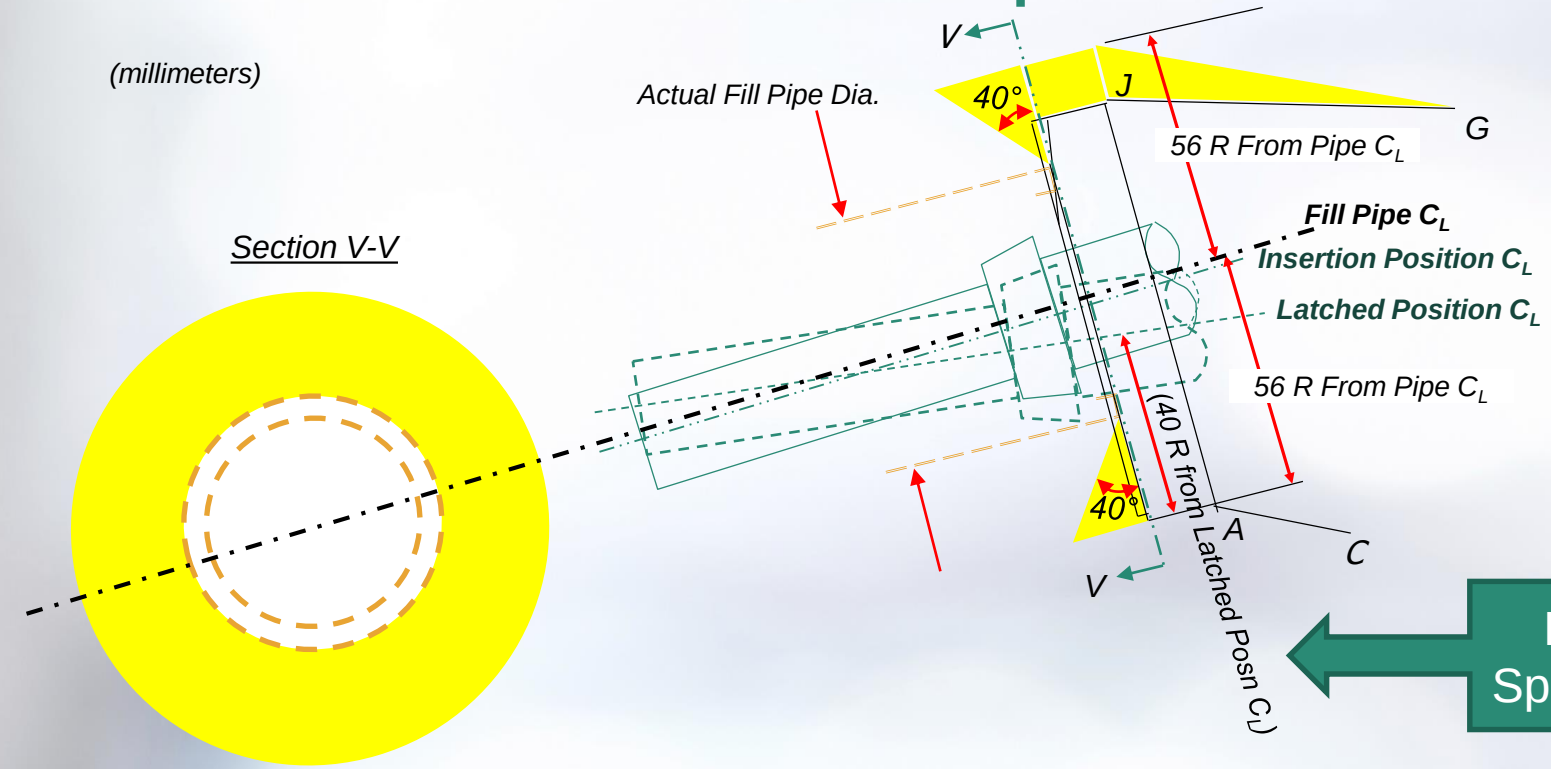
(radial view)

Excerpt From:
ISO 13331:1995(E)

Access Zone Update Concepts

- Adds to current access zone spec
- Based on worst case insertion
- Circular shape (not oval) for simplicity

Access Zone Update Plan



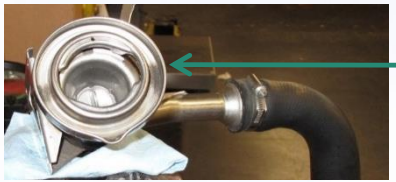
Additional clearance to ISO 13331 access zone, proposed by CARB

CARB

Access Zone Update will affect:

Fill Pipe With Outer Ring

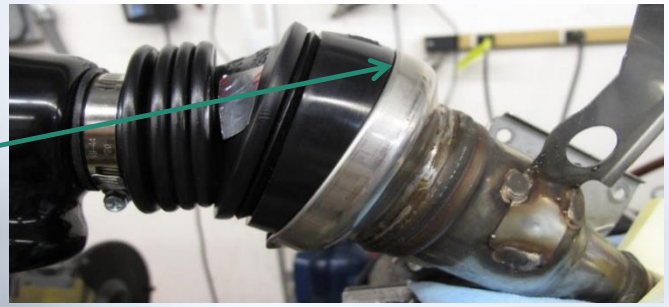
- A current design on some cars



Outer ring

Two different insertion scenarios:

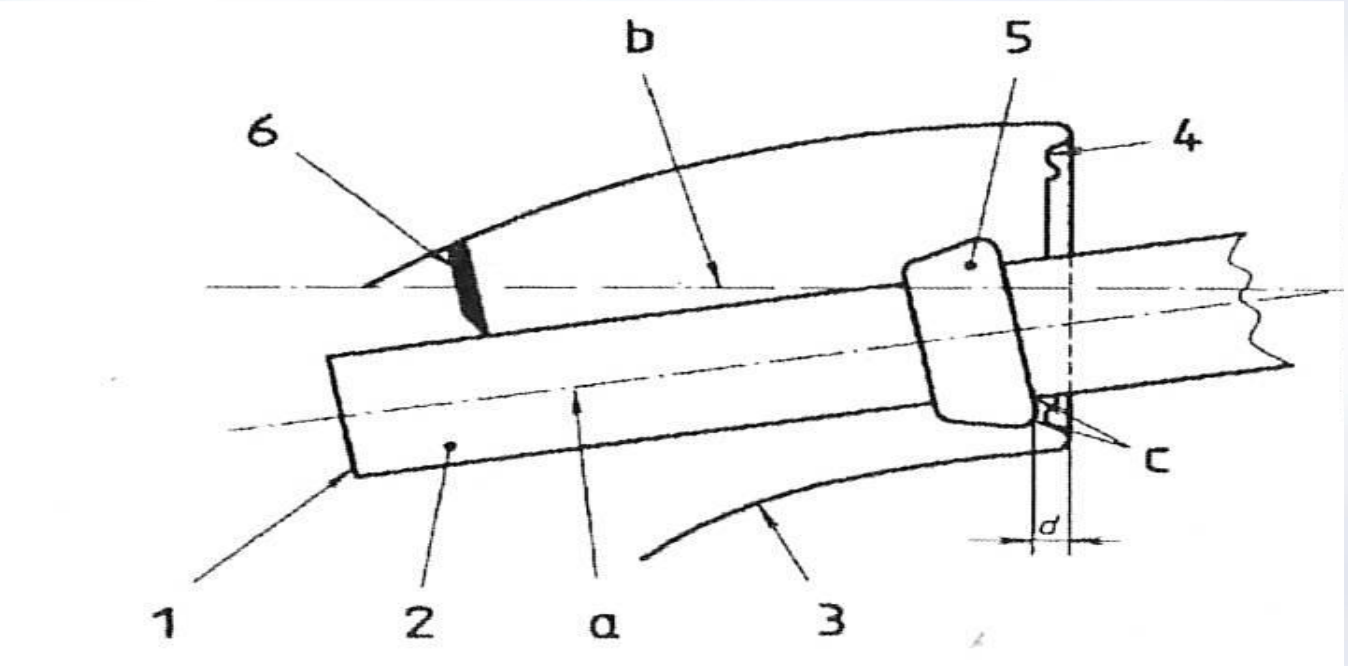
1. Boot butts up against outer ring



2. Boot fits within outer ring

- Operator dependent

Locking Lip Depth



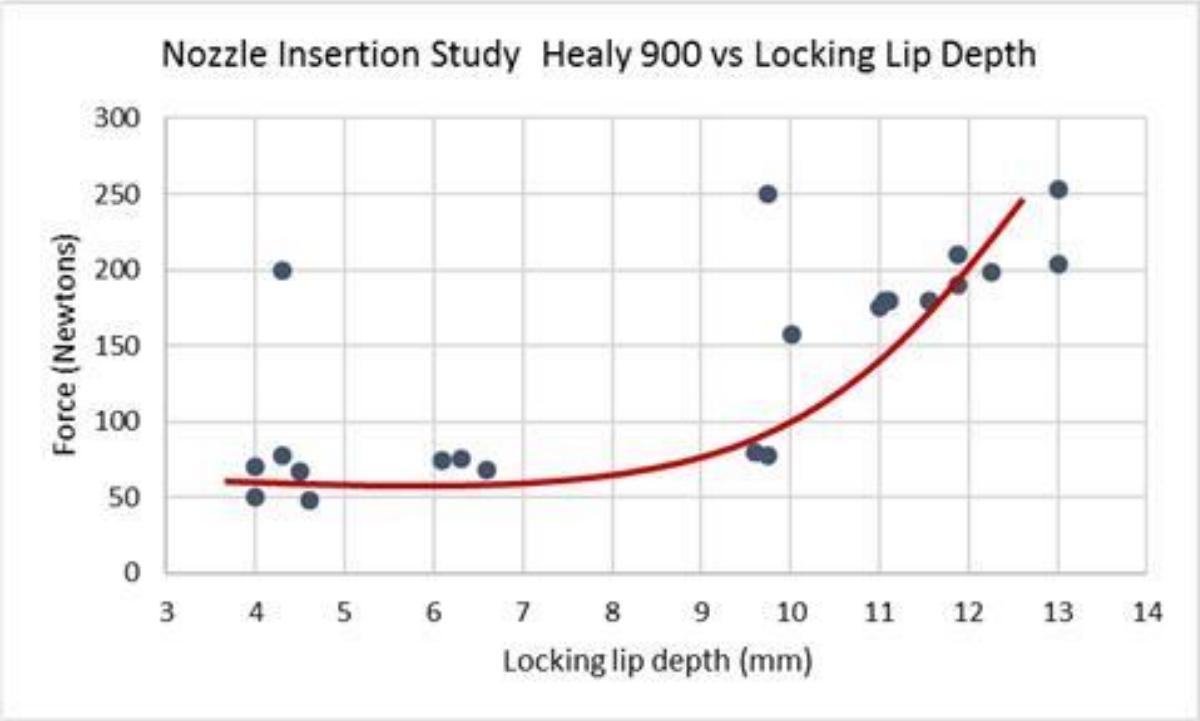
Example: Latched Nozzle

Locking Lip Depth Update

Goal: reduce "loose latching"

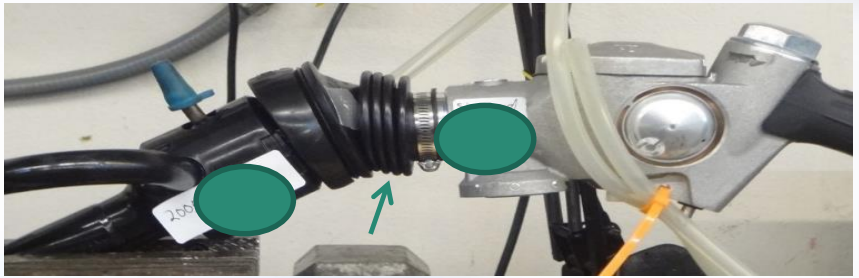
- Current: 4-13 mm
- Planned change: 4-10 mm
- Easier to latch nozzle
- Insertion force increases dramatically > 10 mm
  - Source: SAE nozzle insertion study

SAE nozzle insertion study



Locking Lip Depth Implications

- Fill pipe with locking lip 12-13 mm deep:
  - Boot fully compressed



- Fill pipe with locking lip 5 mm deep:
  - Boot not fully compressed

ISO 13331 → SAE J1140

- CARB currently adopts ISO 13331
- Considering dropping ISO 13331 and adopting an updated SAE J1140 instead
- SAE Fuel Systems J285/J1140 Task Force is working on update of SAE J1140
  - Very similar to current ISO 13331
  - New SAE J1140 will have improvements covered in previous slides: performance test, access zone update, and locking lip update

CONSIDERING TO REMOVE OPTION TO FORGO SPITBACK / PSO TESTING

Considering to remove Spitback / PSO exemption

- Used to be a CA requirement prior to 2014
- CARB aligned with US EPA in 2014 and removed it
  - Basis: Current ORVR testing is sufficient
  - CARB added the exemption in the CA ORVR reg
- This was a mistake, since ORVR is tested with a nozzle w/o vapor recovery
- Procedure is still in CA Fill Pipe Specification
- Will require CARB to open up the ORVR reg and remove this exemption

Other Minor Changes

- Clarify important specification aspects
  - Outer diameter & sealing surface
- Clean up (obsolete references)

Timeline: Regulation & Implementation

- Stakeholder comments welcome at any time during this process
- Summer Workshop
- ISOR released – September 4th, 2018
- Board hearing: October 25-26, 2018
- Four-year lead time for manufacturers to implement changes: 2022

Contact Information

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